

The phase diagram of the high temperature superconductors as seen by ARPES

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The superconducting phase transition in the underdoped high temperature superconductors is rather unusual, in that it is not a mean-field transition as other superconducting transitions are. Instead, it is observed that a pseudogap in the electronic excitation spectrum appears at temperatures T^* higher than T_c , while phase coherence, and superconductivity, are established at T_c . One would then wish to understand if T^* is just a crossover, controlled by fluctuations in order which will set in at the lower T_c , or whether some symmetry is spontaneously broken at T^* . Using angle-resolved photoemission with circularly polarized light, we find that, in the pseudogap state, left-circularly polarized photons give a different photocurrent than right-circularly polarized photons, and therefore the state below T^* is rather unusual, in that it breaks time reversal symmetry. On the other hand, in the overdoped region, we find evidence for a new crossover line in the phase diagram between a coherent metal phase for lower temperatures and higher doping, and an incoherent metal phase for higher temperatures and lower doping. The former is characterized by two well-defined spectral peaks in ARPES due to coherent bilayer splitting, whereas the latter is characterized by a single broad spectral feature in ARPES. In this talk we will discuss how the pseudogap and the coherent to incoherent crossover manifest themselves throughout the phase diagram.